



NASA STTR 2010 Phase I Solicitation

T8 Langley Research Center

For Space Environment Resistant Materials there are opportunities to improve the performance of engineering materials that support spacecraft performance, lifetime, and mission assurance. Areas of opportunity to improve material performance for low earth orbiting satellites are reflective coatings and emissive coatings that maintain properties for extended periods with resistance to high-energy radiation and atomic oxygen. Other areas of interests include materials that resist internal electrostatic discharge in highly charged radiation belt environments. The outer planet environments, such as Jupiter, have predominantly highly charged trapped electrons, which pose challenges for protecting critical spacecraft components inside the bus from internal electrostatic discharge. Charged environments can be on Earth at geosynchronous and medium orbits where interactions with trapped radiation belts that are charged by solar space weather are prevalent. Polymeric and composite materials that can assist in reducing adverse affects of spacecraft charging and internal electrostatic discharge are sought without the loss of coating, electrical, adhesive, thermal, and mechanical properties. Research and development of space environment resistant materials support the mission assurance of NASA earth science, exploration, and space science spacecraft missions outlined in the decadal survey.

Subtopics

T8.01 Flexible Charge Dissipation Coatings for Spacecraft Electronics

Lead Center: LaRC

Participating Center(s): JPL

Many NASA spacecraft and satellites operate in radiation environments: geostationary and medium earth orbits, radiation belts in the outer planets, solar wind, and Lagrangian points near the sun. With highly charged particles that penetrate spacecraft, internal electrostatic discharge risks mission assurance. The Jovian environment has radiation levels 7 times greater than Earth's geostationary orbit, which is the NASA Europa Jupiter System Mission environment. In order to reduce the risk of internal electrostatic discharge on sensitive spacecraft electronic components, NASA seeks a conformal conductive coating that dissipates charge on the surface of electronic boards. It is highly desired for the coating to be applied to electronic boards using a standard industry method such as painting or other brush technique in a cleanroom environment. The coating must dissipate charge, have low outgassing, and have low water absorption. The coating is highly desired to be optically clear for visual inspection of components. The coating is also highly preferred to be thermoplastic for removal if needed. The minimum maximum service temperature for the coating is 70 deg C. Charge dissipation testing can be done using electron gun, which can be screened using a scanning electron microscope (SEM). At the macroscopic level, the volume resistivity of the conductive coating must be in the range of 1×10^8 to 10^{12} ohm cm. The paint or coating must be able to adhesively bond to conventional electronic epoxy and polyimide circuit boards without damaging metal

circuits, resistors, capacitors, and semiconductor surfaces. Improved charge dissipation supports the mission assurance of NASA satellites and spacecraft that operate in charging environments.

T8.02 Spacecraft Internal Electrostatic Discharge (IESD) Resistant Circuit Board Materials

Lead Center: LaRC

Participating Center(s): JPL

The improvement in the performance of spacecraft circuit board materials with resistance to IESD will enhance performance, lifetime, and mission assurance. Circuit boards are sought from composite materials, such as graphite fibers and epoxy or polyimide resins that dissipate electron charge. It is important for the circuit board materials to be compared for circuit board physical properties (dielectric constant, temperature range, breakdown voltage, coefficient of thermal expansion, and etc.) with the current commercial state of the art materials, such as FR4 and others. A typical volume resistivity of 10^{12} ohm cm is needed for the circuit board material and the ability to leak electron charge at the microscopic level. Charge dissipation studies can be initially performed by electron gun or scanning electron microscope (SEM) for initial screening. The outer planet environments, such as Jupiter, have predominantly highly charged trapped electrons, which pose challenges for protecting critical spacecraft components inside the bus from internal electrostatic discharge. Charged environments can be found at geosynchronous and medium Earth orbits where interactions with trapped radiation belts that are charged by solar space weather are prevalent. Polymeric and composite circuit board materials that can assist in reducing adverse affects of internal electrostatic discharge are sought without the loss of electrical, thermal, and mechanical properties. Research and development of spacecraft IESD resistant circuit board materials support the mission assurance of NASA earth science, exploration, and space science missions outlined in the decadal survey.

T8.03 Innovative Green Technologies for Renewable Energy Sources

Lead Center: LaRC

NASA is interested in advancing green technology research for achieving sustainable and environmental friendly energy sources for terrestrial and space applications. Dependence on fossil fuels has to be balanced with other potential sources of energy for minimizing deleterious effects of their byproducts. In the case of Lunar, Mars and other planetary explorations including development of human habitats, use of clean and renewable energy sources would help advance mission objectives to a greater extent besides reducing waste products.

Proposals are sought to develop innovative renewable sources of energy that generate minimal emissions, environmentally safe and are sustainable over extended periods of time. Proposed technologies should advance the state-of-the art systems and/or components by focusing on techniques that either reduce or replace the use of fossil fuels in a cost effective manner.

Clean energy source technologies and methodologies including but are not limited to those based on solar, wind, hydro, biomass, geothermal, and atmospheric constituents such as hydrogen, carbon dioxide are solicited. Innovative space based solar power generation and effective transport to benefit terrestrial and space applications are desired. Proposals related to efficient operation over wide temperature ranges under harsh environmental conditions are also sought. Energy sources that enable future missions which otherwise would be difficult with conventional resources are desired.